

PROGRESS REPORT
ON
THE FIRST TEAK TREE-SHOW IN THAILAND.¹

by

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1. TEAK TREE BUDDING IN OTHER COUNTRIES

The vegetative propagation of forest trees has been done in Europe, America and in Asia, especially in Japan, for more than 30 years. It is well developed in several countries where intensive forest management is practiced as in Denmark, Sweden, Finland, Japan and the United States of America. However, this work has been done mostly with temperate tree species. The vegetative propagation of teak has been tried in a few countries in recent years and the possibilities of budding teak have been demonstrated here and there, but little is known about how to bud and when to bud (*Va Alphe De Vee* 1954, and *Hellinga* 1956).

2. TEAK BUDDING IN THAILAND

Like the geneticists, Thai foresters know that good trees will produce good seeds and good generations in the future, and everybody agrees that seedlings from certified seeds only should be used in forest plantations. But, there is yet little application of this knowledge in Thailand, thus information concerning the propagation of superior forest tree species by vegetative means is much needed.

The first experiment with the budding of teak in Thailand was initiated by the author in 1957 at the School of Forestry in Bangkok, with buds obtained from the vicinity of Prae, a town in Northern Thailand, he used the "T" method to bud stocks planted in pots and wrapped the budded areas with waxy

1. "Tree-show" is a Danish term designating an area where trees are propagated by vegetative means.

binding cloth. The stocks were dry before budding and the cambium especially, was further damaged when opening the "T" on the stocks. However, 3 out of 10 budded teaks survived and were transplanted in the backyard of the School of Forestry. Accidentally they were drowned two years later but not before Dr. *S.C. Larsen* and Dr. *K. Gram* of the Danish Botanical Association had taken pictures of one of them. That was the beginning of teak budding in Thailand (Fig. 1).

In 1959 Mr. *H. Keiding* of the Hørsholm Arboretum, Denmark was sent to Thailand by the Royal Danish Botanical Research Institute to investigate the propagation of teak and to encourage Thai foresters in the field of forest genetics. At that time Mr. *Keiding* had already had 5 to 6 years experience with rubber vegetative propagation. It was he, who had the idea that teak and rubber are both broad-leaved species, both are thick-barked trees and they could be treated the same. The budding method successfully used in rubber propagation is called "*Forkert*" or "*Shield Budding*". This method is used in teak as well. Mr. *H. Keiding* arrived at Mae Huat Teak Plantation in Northern Thailand during the early part of April 1959, and with the cooperation of Mr. *Boonyong Mueangphra* of the Royal Thai Forest Department, started the first teak tree-show in Thailand.

3. OBJECTIVES

The teak tree-show at Mae Huat was started to determine whether or not teak in Thailand could be budded in the field, how successful it might be and the most suitable time to do the budding.

The long term objectives of a teak tree-show in Thailand are to collect indigineous and exotic teaks from many places, with many different characteristics or strains and to grow them in one place for the following purposes:

- (a) As a source of material for further propagation of seed orchards in the future.
- (b) To make available in the future teaks from many localities and of many varieties or races for close study as needed.

Figure 1.
Budding teak by the "T" Method



A. Stock and sprouting bud.



B. Cut back the stock and let the attached bud grow.

- (c) To maintain green specimens of the best teaks before they are cut by legal or illegal means.
- (d) To make available stocks for breeding in the future.
- (e) To study teak propagation by budding, a procedure which is still new in this country, and to gain more experience in vegetative propagation.

4. SITE

Selection of site for the teak tree-show is important because several factors should be considered to obtain maximum benefits from the work. Requirements for a suitable site were set by the foresters and forest geneticist who planned the initial project, as follows :

- (a) The location should be accessible for purposes of inspection and easy working conditions.
- (b) The area must be large enough for the purpose.
- (c) The surface of the ground should be level or nearly so for easy maintenance.
- (d) Good soil and ample soil moisture were needed because a teak tree-show should be treated as a fruit orchard.
- (e) A one year old teak plantation is needed because at that age the size of the teak stock will be suitable for budding; the stump will be about 1 to 3 centimeters in diameter and its thin bark can be peeled or ripped off easily.

After looking at several places we selected Huay Ngawn (Ngawn Creek) teak plantation, Mae Huat (Huat River), Ampur Ngao (Ngao District), Changvat Lampang (Lampang Province), in Northern Thailand, as the budding plot. It is about 680 kilometers from Bangkok, in the middle of a teak-bearing area. Part of this plantation and teak stocks from it are being used in the vegetative propagation or budding of teak.

5. CLONE COLLECTION

For the purposes that have been mentioned above, teak is to be selected according to characteristics as follows:

- (a) Straight, long and clear bole.
- (b) Healthy symmetrical crown.
- (c) Vigorous and rapid growth.
- (d) Stunt or dwarf form.
- (e) Other abnormal form.

Therefore, the selection of buds from clones with known characteristics will depend on the purposes or needs of the collection.

At the Mae Huat tree-show 11 teak trees were selected and marked with letter "S.G." (Scion for Forest Genetics Studies) and numbered in Roman numerals. The height, girth, age and purpose of selection of the individual trees is given in Table 1.

S.G. I, IV, & V are mature trees of forestry value in the natural forest.

S.G. II, III, VII, VIII, IX and XI are teaks in a plantation not more than 18 years of age. The object is to determine:—

- (1) Teak flowering is due to genetics or heredity, and
- (2) Flowering in the young stage may produce big branches (*Larsen & Gram*, 1958).

S.G. VI is a mature tree of moderate forestry value in the natural forest. Buds were collected from the upper (mature) and lower (juvenile) parts of the tree and also from S.G. V. The object is to compare the growth and to determine which bud can carry its branch characteristics and for how long.

We had to divide the 11 clones into two small plots because of the difficulty in selecting a good site, but the plots are close to each other. There are five clones in the first plot and six in the second plot.

6. BUDDING SEASON

Teak can be budded the whole year round, but there are less problems in the dry season than in other seasons. The best time to bud in Thailand is from the middle of April to the middle of May, which is about the end of the dry season, because:

TABLE 1
Teak trees selected for propagation

Tree No.	Total Height m.	Girth at b.h. cm.	Age Years	Purpose of selection
S.G. I	25.0	160	80	Forestry value, natural teak forest
S.G. II	17.5	68	17	Forestry value, plantation, flowering relatively late in life.
S.G. III	18.0	65	15	Forestry value, plantation, late flowering.
S.G. IV	33.4	264	80-90	Forestry value, natural forest, very fine phenotype.
S.G. V	29.0	172	60	Forestry value, natural forest.
S.G. VI	28.0	209	70-80	Moderate forestry value, natural forest.
S.G. VII	17.3	91	13	Forestry value, plantation, late flowering.
S.G. VIII	15.6	96	13	No forestry value, plantation, early flowering.
S.G. IX	17.0	61	15	Little forestry value, plantation, early flowering.
S.G. X	17.5	56	15	Forestry value, plantation, late flowering.
S.G. XI	19.5	64	15	Forestry value, plantation, late flowering.

From " Budding and grafting of teak (*Tectona grandis*) " by Mr. H. Keiding in Nat. Hist. Bull. Siam Society, Vol. 20, 1961.

- (a) At that time of the year buds are still healthy and have not started to swell or sprout; we can say that they are still in the dormant stage.
- (b) After the first rain of the year (about the early part of April) when there is some moisture in the soil to feed the tree. Cellsap will start to be active and flow up to the top of the tree and we can peel off the bast without damage to the cambium.
- (c) There is not enough cellsap at that time to obstruct the connection of the bud to the stock and the callus does not grow fast enough to cover the bud before it sprouts.
- (d) It is the beginning of the growing season and the bud will have a chance to grow during the whole season.
- (e) It is a very convenient time for men to work in the field because the weather is still quite dry with little rain and no high grass, mosquitos or gnats to bother them during the operation.
- (f) Rain are not frequent during the early part of the rainy season and the buds will not be rotted or spoiled due to prolonged wetting of the budded area.

After May all the strong and healthy buds will sprout. The rest will be only the poor and abnormal buds which will cause failures and waste the time in budding. If the budding operation is starting too early, after teak has shed its leaves, it will be very easy to select the buds, but very difficult to cut them out of the wood. At the same time it will be very hard to peel or rip the bark from the stock. Cutting buds and peeling stocks if cause severe damage to the cambium, will be the most common factor preventing successful budding. Budding should not be attempted during the long, dry, warm season because the buds will become dormant or dry up due to lack of moisture in the soil for a long period, thus causing the budding to fail.

7. BUD SELECTION

Bud selection is one of the most important factors in vegetative propagation because the health of the tree will depend on the health or perfectness of the bud. Factors which should be considered in bud selection are age, health and location on the tree.

- (a) **Age.** The age of Teak bud can be determined by observing the density of leafscars on the nodes. The interval between leafscars means a year of growth. Two-year buds are very suitable because they are neither too young nor too old. Older buds are very difficult to take off from the wood, and younger buds are too thin and channelled.
- (b) **Health.** A healthy bud can be detected by the appearance and characteristics of its branch. The color of the branch will be light grey and glossy, and it will be nearly round instead of quadrangular in shape. The size of the branch should be about that of a thumb.
- (c) **Location.** Buds from branches from different parts of the tree stem grow quite differently in beech. A bud from a mature branch can keep the branch characteristics for years but a bud from a juvenile branch will keep growing as the normal young tree (*C.S. Larsen, 1956*).

8. BRANCH CUTTING FOR BUDS

Branches cutting at the beginning of this kind of investigation is rather difficult, because the trees, which we can be sure of having the ideal characteristics are fully mature of about the timber size, and the branches are high up, more than 25 meters from the ground. Besides, the two-year bud branches are along the edges of the big wide crowns and out of reach by hand. To collect them we had to cut or lop the branches down one by one. Only two-year branches with bud were sorted and collected. These branches are wrapped with moist burlap or jutebag and keep them wet continuously during transportation.

The length of the branch will depend on the kind of transportation and container used. To prevent evaporation both ends of the branches should be dipped in a melted compound of wax and grease, then packed in a paper box or other container and covered with dry sawdust. In case of a long transportation (such as from Thailand to Papua, New Guinea by airfreight) the branches can be kept fresh for more than a week if both ends are dipped in wax or glycerine, and shipped in plastic bags.

9. BUD CUTTING

Selecting the best buds (as discussed previously) is very important in bud cutting because only the best buds will produce perfect budding.

First, use a sharp budding knife to cut buds from two-year branches. The normal size of the budwood will be 6-8 centimeters long. This length can be shaped or cut for insertion into the stock cambium conveniently. Second, buds should be cut deep, partly down into the wood, which will help to keep moisture in the buds for a considerable time after they have been cut. Cutting lines on both sides should be equal distance from the actual bud as possible. Third, put the cut-side down on wax paper or a plastic bag. Fourth, an experienced person on a one-man budding trip can complete cutting about 20 buds before they get dry.

10. BUDDING

When starting a budding operation lightly rub and clean the outer bark as close to the ground level as possible to remove all dirt sticking to the bark surface. Start to cut at 6 to 8 centimeters from the lowest point upward. The length of cut depends on the size of the stock. The width of the cutting line should be about 1 to 2 centimeters, again depending on the size of the stock.

Both cutting lines should meet at their upper ends in the shape of a "U" or "V" upside down. The cutting should be even and deep down into the cambium, so it will be easy to raise

Figure 2
Budding teak by "*FORKERT*" Method in the field.



A. Insert the bud into the upside down 'U' cut.



B. Close the bark flap, over the area with coconut palm leaf tied in place with jute string and shade the area with any big green leaves available.

Figure 3



Growing budded teak.

Figure 4



One year old budded teak on which the budding scar can hardly be seen.

up the flap from the stock. Cutting from the bottom up helps to control the line of the cut. The bud should be shaped until it can be inserted into the stock under the flap. The cutting should be neat and clean, and the bud insertion should be done carefully because a bud inserted up-side-down will sprout slowly and bend down to the ground before starting to straighten up again. Avoid using of any water to clean the buds or do budding while it is raining, because water will remove the cambium cellsap. After properly inserting the bud, the flap should be lifted up to close the budding area. Covering the area with coconut palm leaf, tied in place with jute string, then use big green leaves for shade over the budded teak (Fig. 2).

11. BUDDING TREATMENT

If every thing is normal the callus will grow and try to cover the wound or even the bud itself in about a week. However, for the sake of safety one should wait from 10 to 15 days before opening the bud. Bud opening means removing all the covered materials on the bud. The success of budding can be determined by observing the color and appearance of the bud. If the bud looks as fresh as it was initially made the budding will be successful. But it will be not a success when, the bud has turned dark brown or has shrunk. A bud can also be checked by touching it lightly with a sharp-pointed knife. If the bud is loose in the stock and moves easily, it is also a sign of unsuccessful budding. Donot delay the time of opening the bud because the callus will cover all the budded area and cause trouble in opening up the bud to allow it to grow independently. Cut the stock about 10 to 15 centimeters above the budding place after the bud has started to sprout (Figure 3). When cutting back the stocks examine them carefully and break off all the unwanted sprouting buds, leaving the one which was budded. The budded tree will grow fast. One year after budding it will be hard to see the budding scar as in Figure 4.

12. EQUIPMENT & MATERIAL

(a) In budding three knives are needed and, each of them should be suitably used (Fig. 5).

- (1) A big knife for branches cutting.
- (2) A knife of medium size for pruning the stock and other dressing procedure.
- (3) A budding knife used only for cutting and dressing buds and preparing the insertion on the stock.

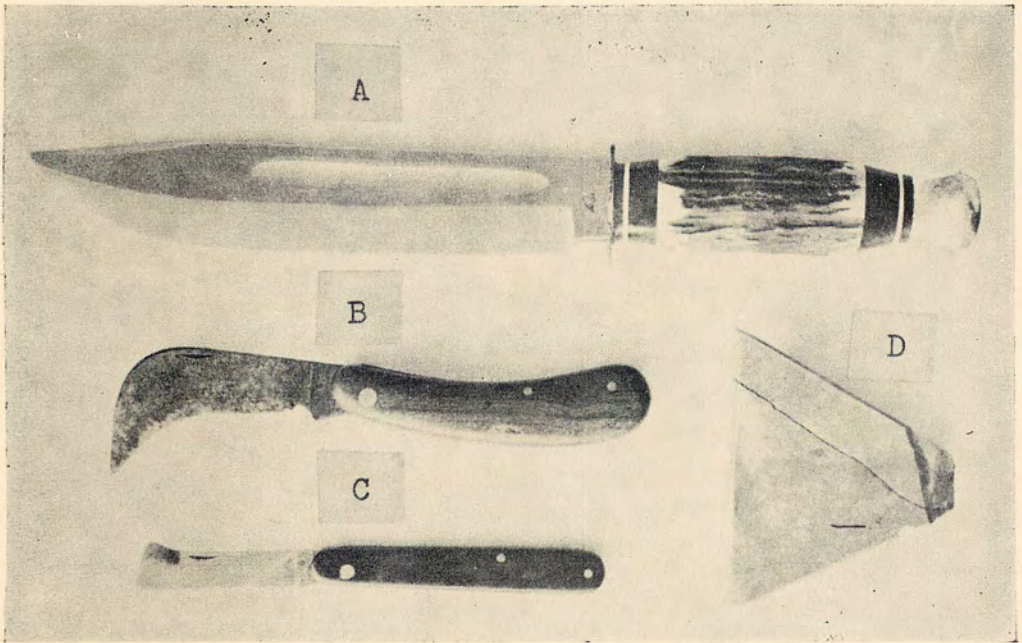
These three knives should be kept sharp and clean at all times during the process, and each should be used only for the purpose described. Using of a dull and dirty budding knife, will spoil the budding operation.

- (b) A sharpening stone and hone are needed to sharpen all the knives during a budding operation. It is recommended that the budding knife be sharpened after budding 10 stocks.
- (c) Coconut palm leaves about 6 to 8 centimeters are needed to wrap and cover the newly budded area.
- (d) Jute string is used to tie the coconut leaf on the budded area tightly to ensure the bud to have good contact with the cambium of the stock.
- (e) Wax paper or a plastic bag is used to prevent the buds from drying up due to evaporation when we have many stocks to bud.
- (f) A paper or wooden box is used to keep all the material and equipment (such as coconut palm leaves, teak buds, jute string, a bag of budding knives, and sharpening stone) in one place, to make them easy to get to and protected from the hot sunshine.

13. INJURY

Actually, there is no danger at all in budding teak if precautions are taken to prevent losses from fire, livestock or local people. In rural areas inquisitive people may untie the jute string before the time of bud opening and thus destroy the budded teak right away. Sometimes the people also start the fire or let the cattle loose to graze in the teak plantations, and the cattle

Figure 5



- A Branch cutting knife
- B Leaf and small branch cutting knife
- C Budding knife
- D Sharpening stone

will break the new shoots growing from the buds which are still tender and brittle. It is better to fence the site in and solicit the villagers who are living around or close to the teak tree-show for their co-operation.

14. TENDING

Destroying all the unwanted buds from the old stocks is the main object of tending a teak tree-show. Fire prevention is another important factor which must be given consideration. Actually, teak tree-shows is quite an investment and it is worth-while to protect from destruction by all means. Our teak tree-show started in 1959, and was thinned in 1962 to give a normal growth of the teak. Weeding should be done all year round.

15. PROGRESS RESULT OF THE TEAK TREE-SHOW

The result of the experiment in teak budding can be summarized as follows:—

- (a) If the weather is favorable budding will be at least 65 per cent successful. With more experience, and if the time of budding is right success may be increased to 100 per cent.
- (b) Budding in the early part of the growing season allows time for the bud to grow for a long period. If budding is done lately the bud will become dormant and start to grow again in the next growing season.
- (c) The "*Forkert*" method is better than the "*T*" method because the previous method makes less damage to the stock cambium than the latter.
- (d) Covering the budding area with coconut palm leaf tied with jute string is better than waxy bandage or plastic ribbon because the former are cheaper and more convenient to use.
- (e) Buds from the juvenile branches show more girth increment than buds from mature branches (Table 2).

- (f) We can see some characteristics of trees growing from different clones and can make comparisons between these clones (Figure 6, 7, 8, 9 & 10).
- (g) No difference was observed in the characteristics between trees growing from mature and juvenile buds except girth increment (Figure 11 & 12).
- (h) The budded teaks are growing very well and equal to other teaks in the plantation. Besides the leading shoots there are more branches in the budded teaks than in the ordinary teaks. In 1961 or about two years after budding, there were two tree from S.G.I in flower and three trees from S.G. VIII. In 1962 there were fourteen trees in flower including four trees from S.G.I; one tree each from S.G. III, V (mature type), VI, and VII; two trees from S.G. IV; and four trees from S.G. VIII clone.
- (i) No good seeds were available in the first year of flowering.

Seed production in the second year of flowering (1962) was as follows:

Clone	Number of seeds per clone	Number of seeds per tree
S.G. I	537	134
S.G. III	58	—
S.G. IV	110	55
S.G. V	105	—
S.G. VI (juvenile)	46	—
S.G. VII	480	—
S.G. VIII	820	205

S.G. VIII produced the largest number of seed. This clone also flowered early and developed too many branches (Fig. 13).

Fig. 6



S.G. I In natural teak forest, 25 cm. high, 160 cm. girth,
16 m. clear bole.

Fig. 7



S.G. I Clone 1960

Fig. 8



S.G. I Clone 1961

Fig. 9



S.G. I Clone 1962

Fig. 10



S.G. I Clone 1963

Fig. 11



S. G. V Clone Bud from mature type branch 1963

Fig. 12



S.G. V Clone Bud from juvenile type branch 1963

A



Fig. 13 S.G. VIII.

A. S.G. VIII tree

B. S.G. VIII clone in
flower 1962.

C. S.G. VIII clone in
dry season 1962.

B



C



TABLE 2

Growth of budded teaks in the Teak Tree-Show established in 1959.

Clone No.	1960		1961		1962		Remark
	Girth cm.	Height m	Girth cm	Height m	Girth cm	Height m	
S.G. I	31.8	4.7	32.6	8.0	36.2	8.7	Mature Juvenile Mature Juvenile
S.G. II	23.6	3.9	23.6	6.9	27.3	7.7	
S.G. III	28.0	4.7	31.1	7.9	36.9	8.7	
S.G. IV	30.3	4.3	31.4	7.4	34.7	8.5	
S.G. V	28.7	4.5	33.0	7.9	32.7	8.8	
S.G. V	31.3	5.1	31.3	8.4	36.8	9.7	
S.G. VI	25.7	4.0	26.6	6.8	28.9	8.0	
S.G. VI	25.5	4.1	27.2	6.7	33.1	8.0	
S.G. VII	28.8	4.4	32.5	7.7	40.9	9.1	
S.G. VIII	28.8	4.2	29.3	7.3	35.9	8.2	
S.G. IX	26.9	3.5	26.9	6.4	33.7	8.0	
S.G. X	29.5	5.0	31.4	7.7	38.4	9.2	
S.G. XI	24.2	4.4	24.3	6.5	26.8	8.7	

We suspect that these characteristics may be subject to genetic control.

16. BENEFITS FROM THIS INVESTIGATION

Thailand has started a *Teak Tree-Show* which is more than three years old. The knowledge and experience gained will lead to the collection of elite teak trees from every part of the country for the purpose of developing a seed orchard in the future. Two hectares of teak seed orchard were established in 1961 (160 kilometers from Bangkok) by means of vegetative propagation. We do know that this practice is not pure breeding but it is a step toward it. We can start to work on breeding when the tree-show is old enough, probably in 4 to 5 years from the time of budding. This tree-show can produce some seeds for further investigation in the future. The clone collection will be enlarged to make sure that the number of budded

teak is sufficient to propagate a big seed orchard that can supply enough seed for 2,500 hectares of teak plantation each year. In the mean time the collection of clones can be of great benefit to Thailand as a protected source of superior stock while the number of good seed trees or elite trees in the forests is continuously being depleted by legal or illegal cutting.

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